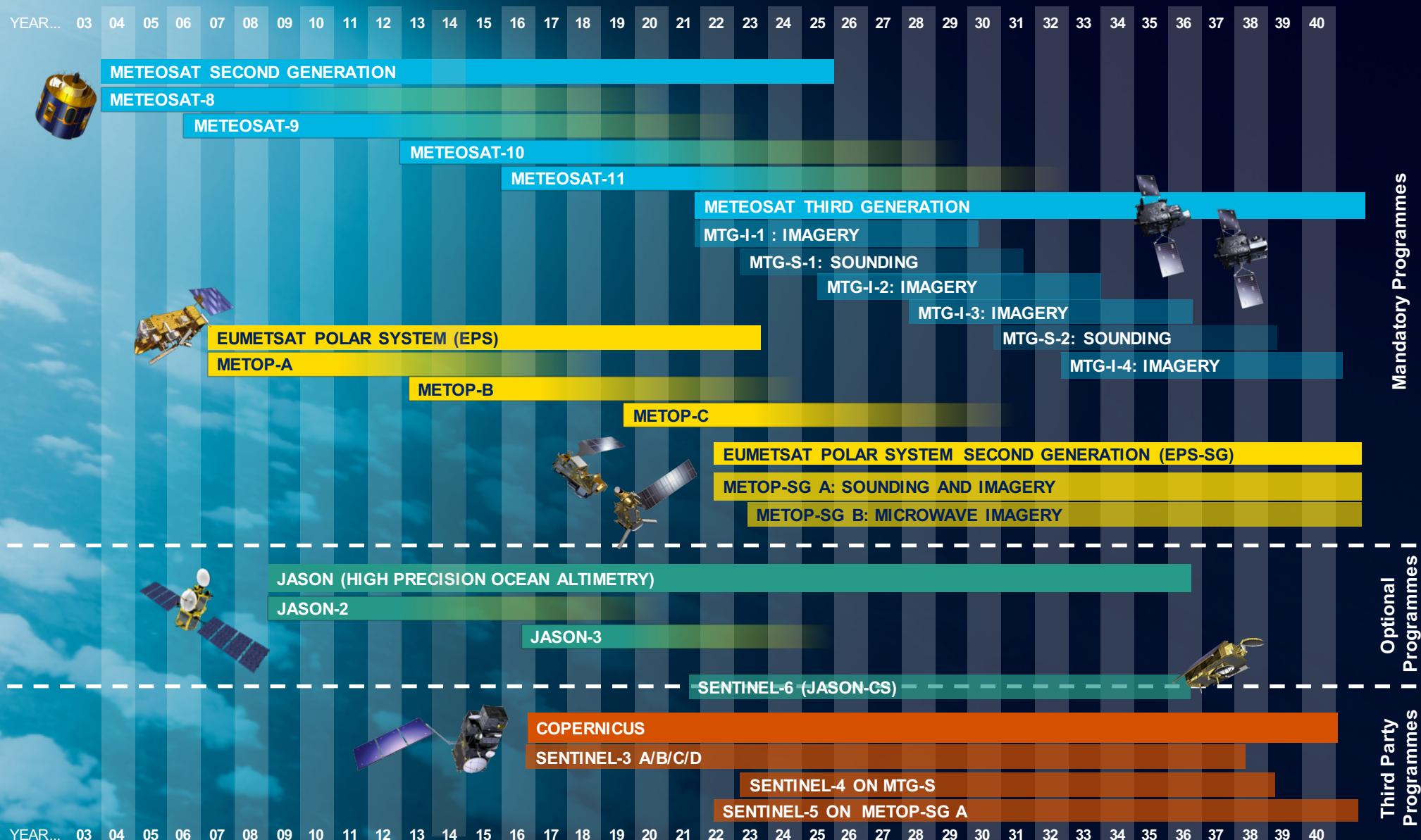


# Monitoring Weather and Climate from Space

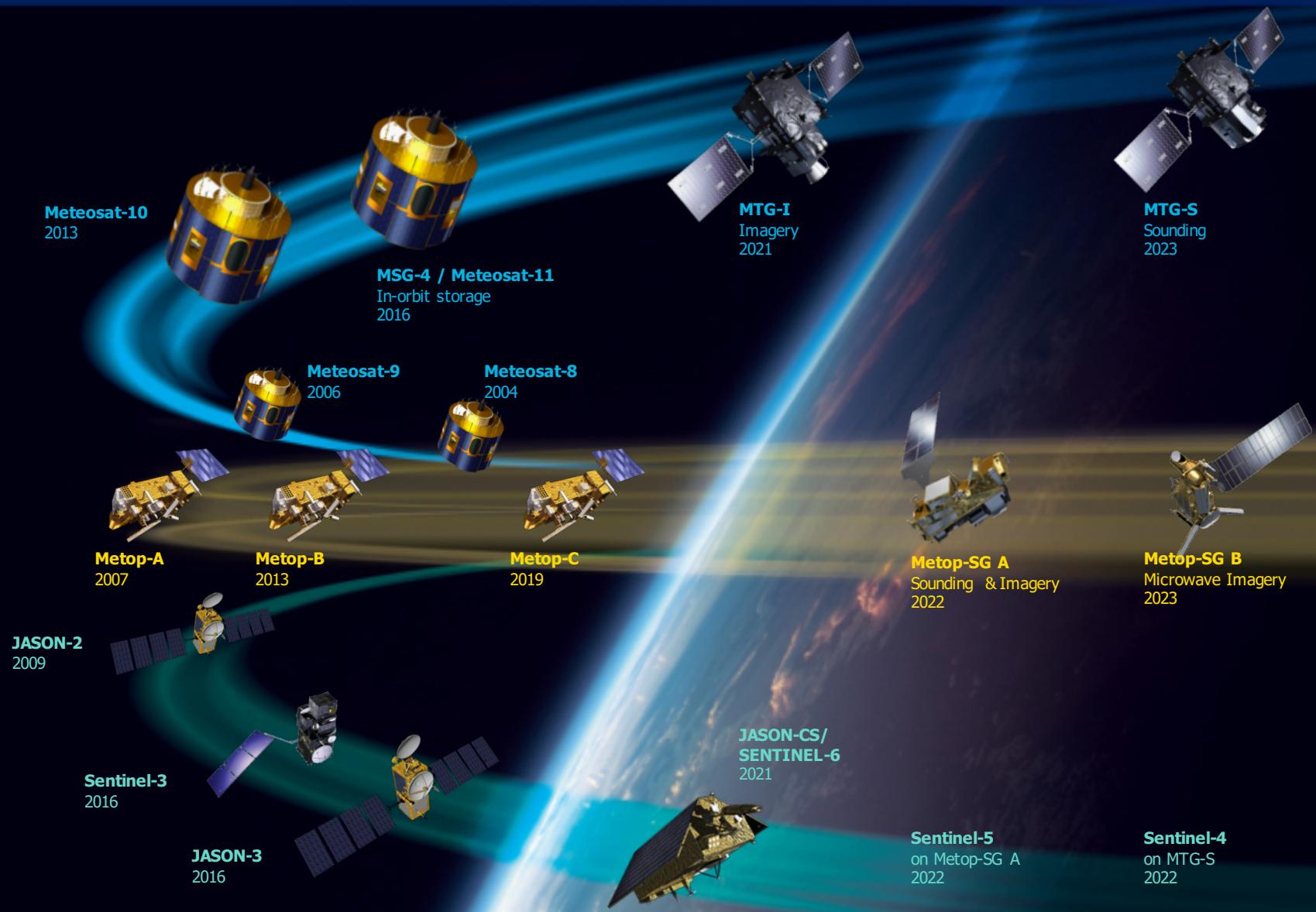
July 2017



# EUMETSAT mission planning



# EUMETSAT mission planning



# Current EUMETSAT satellites

## METOP-A & -B ( $98.7^\circ$ incl.)

LOW EARTH, SUN-SYNCHRONOUS ORBIT

EUMETSAT POLAR SYSTEM (EPS) /  
INITIAL JOINT POLAR SYSTEM

## SENTINEL-3 ( $98.65^\circ$ incl.)

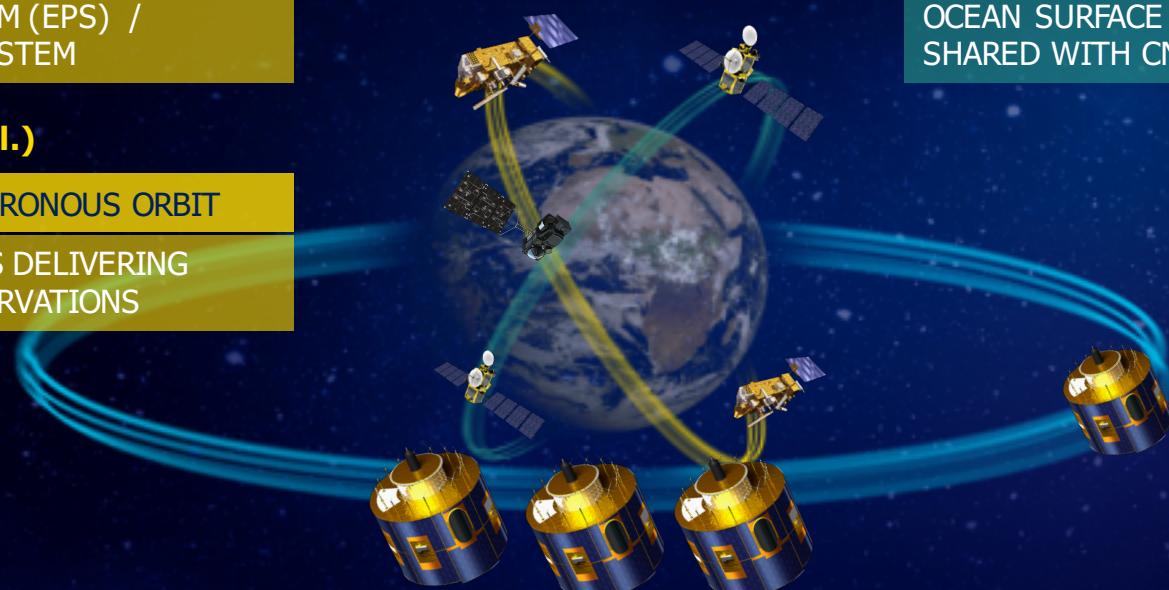
LOW EARTH, SUN-SYNCHRONOUS ORBIT

COPERNICUS SATELLITES DELIVERING  
MARINE AND LAND OBSERVATIONS

## JASON-2 & -3 ( $63^\circ$ incl.)

LOW EARTH, NON-SYNCHRONOUS ORBIT

OCEAN SURFACE TOPOGRAPHY MISSION,  
SHARED WITH CNES/NOAA/EU



## METEOSAT-9, -10, -11

GEOSTATIONARY ORBIT

METEOSAT 2<sup>ND</sup> GENERATION

## TWO-SATELLITE SYSTEM

FULL DISC IMAGERY MISSION (15 MINS) (METEOSAT-10 ( $0^\circ$ ))  
RAPID SCAN SERVICE OVER EUROPE (5 MINS) (METEOSAT-9 ( $9.5^\circ$  E)))

*METEOSAT-11 STORED IN ORBIT (UNTIL MID-2018)*

## METEOSAT-8 ( $41.5^\circ$ E)

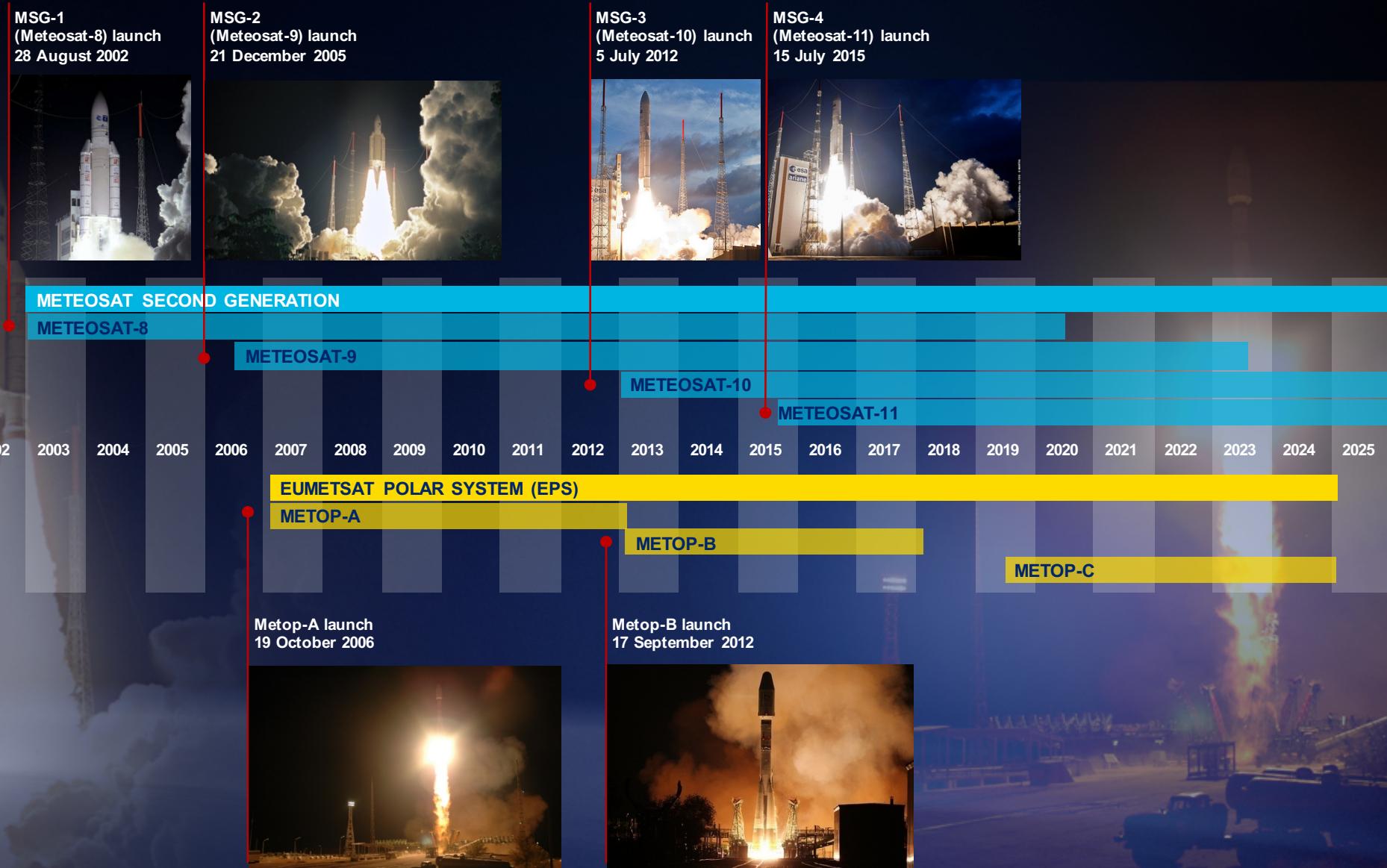
GEOSTATIONARY ORBIT

METEOSAT 2<sup>ND</sup>  
GENERATION PROVIDING  
IODC FROM FEBRUARY  
2017 – MID-2020

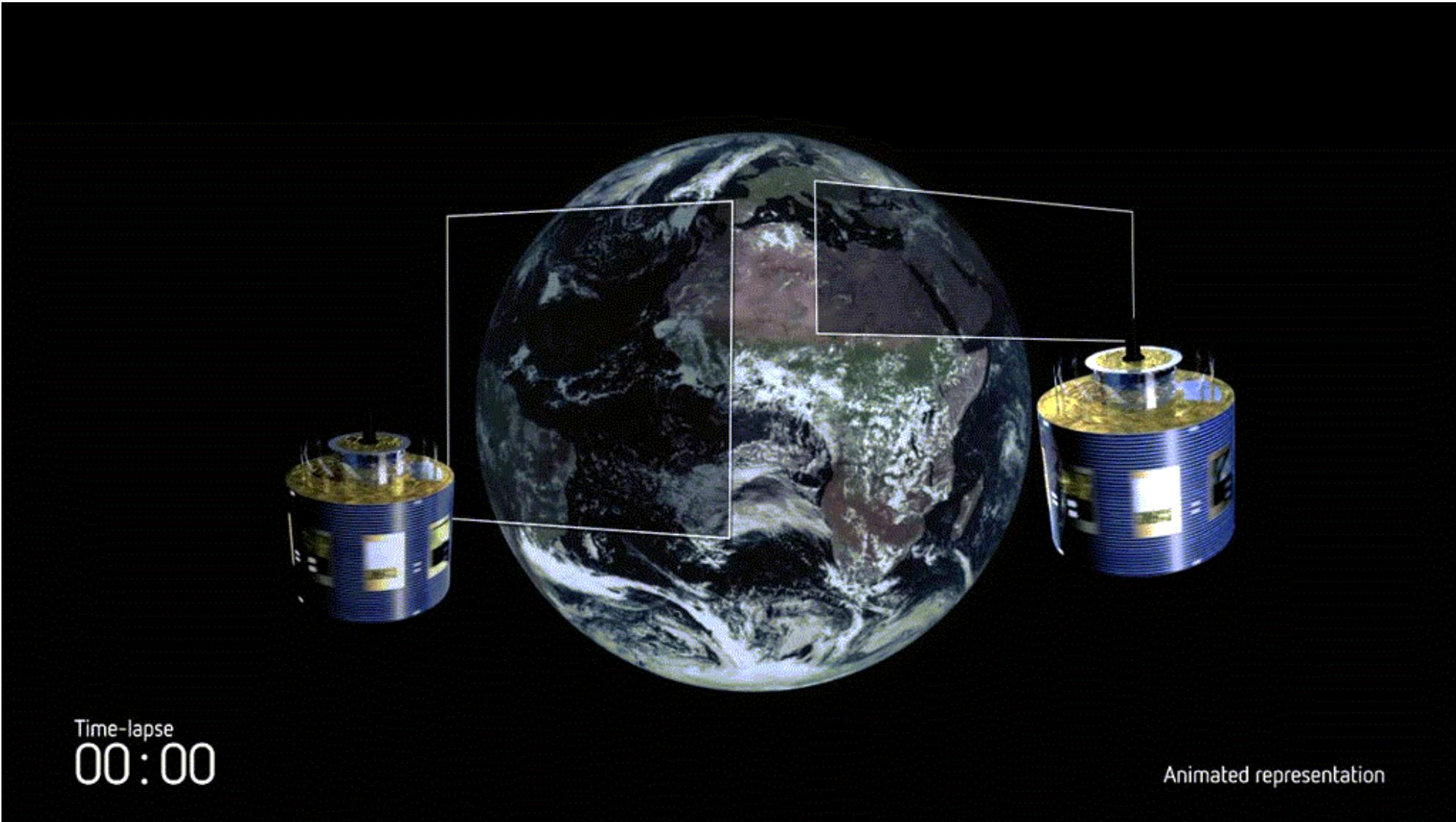
# Current EUMETSAT satellites



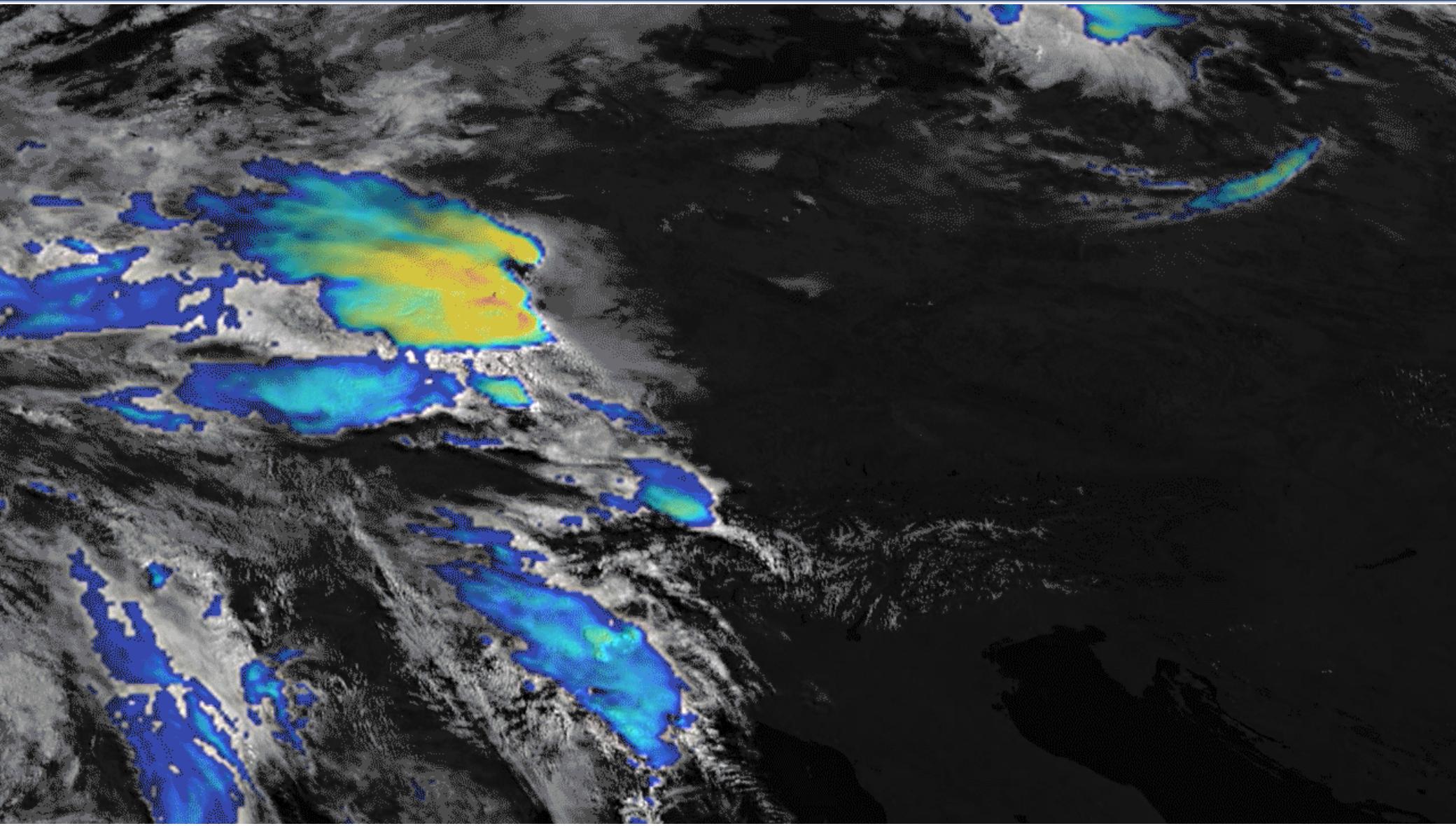
# Deploying the MSG and Metop satellites



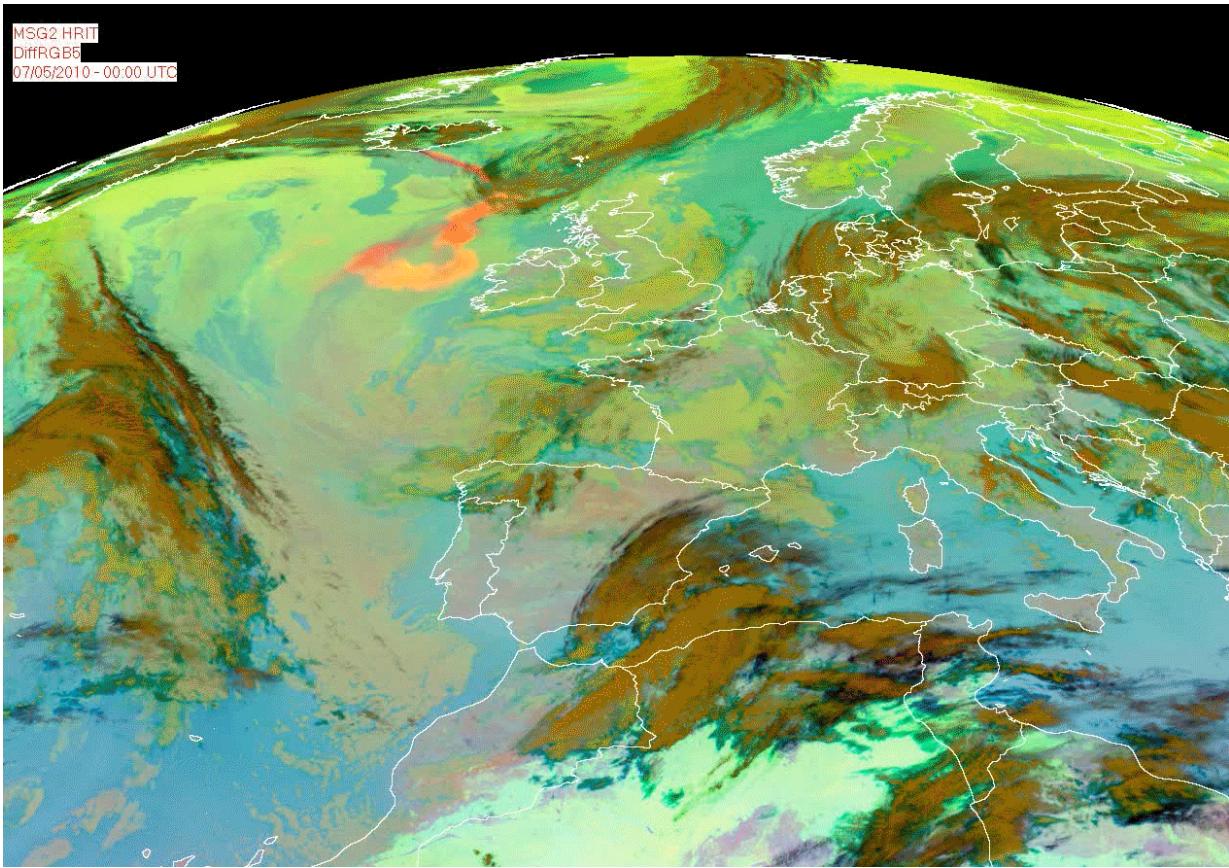
# Meteosat Second Generation: a two-satellite operational system



# MSG for nowcasting of severe weather: thunderstorms

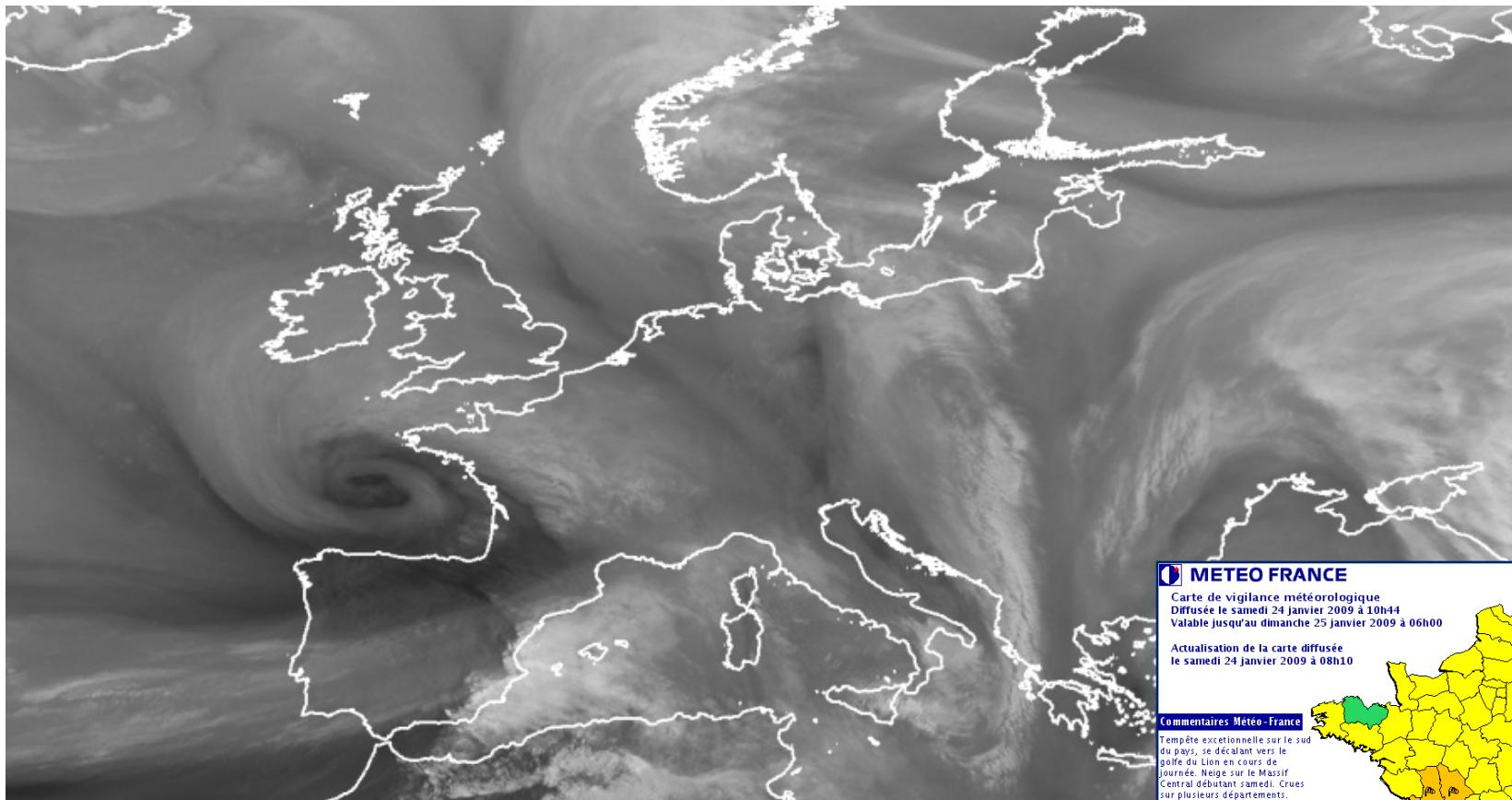


# MSG for transport: aviation



Eyjafjallajökull ash cloud from 7 to 11 May 2010 (second eruption)

# MSG for confirmation of forecasts



## METEO FRANCE

Carte de vigilance météorologique  
Diffusée le samedi 24 janvier 2009 à 10h44  
Valable jusqu'au dimanche 25 janvier 2009 à 06h00

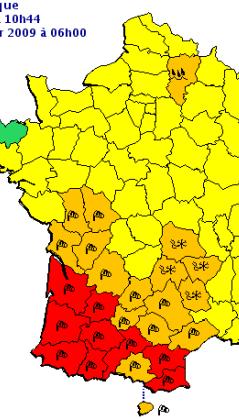
Actualisation de la carte diffusée  
le samedi 24 janvier 2009 à 08h10

### Commentaires Météo-France

Tempête exceptionnelle sur le sud du pays, se décalant vers le golfe du Lion en cours de journée. Neige sur le Massif Central débutant samedi. Crues sur plusieurs départements.

### Conseils des pouvoirs publics

Vent/Rouge – Restez chez vous et évitez toute activité extérieure. Si vous devez vous déplacer, soyez très prudentes. Empruntez les routes principales de circulation. Prenez les précautions qui s'imposent face aux conséquences d'un vent violent et n'intervenez surtout pas sur les toitures. Neige-Verglas/Orange – Respectez les restrictions de circulation et déviations. Crues/Orange – Exitz les abords des cours d'eau. Soyez prudents face au risque d'inondations.



- Vent violent
- Pluie - Inondation
- Orages
- Neige - Verglas
- Grand Froid
- Avalanches

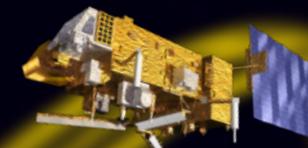
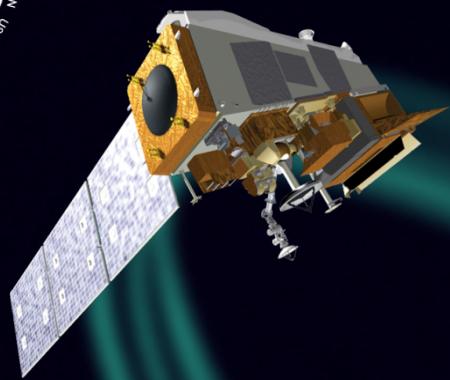
Rouge : Une vigilance absolue. Il existe un risque très important pour la sécurité publique. Restez chez vous et suivez régulièrement au courant de l'évolution de la situation et respectez les recommandations de sécurité émises par les pouvoirs publics.

Orange : Soyez très vigilants; des phénomènes dangereux sont possibles. Tenez-vous au courant de l'évolution de la situation et suivez les conseils de sécurité émis par les pouvoirs publics.

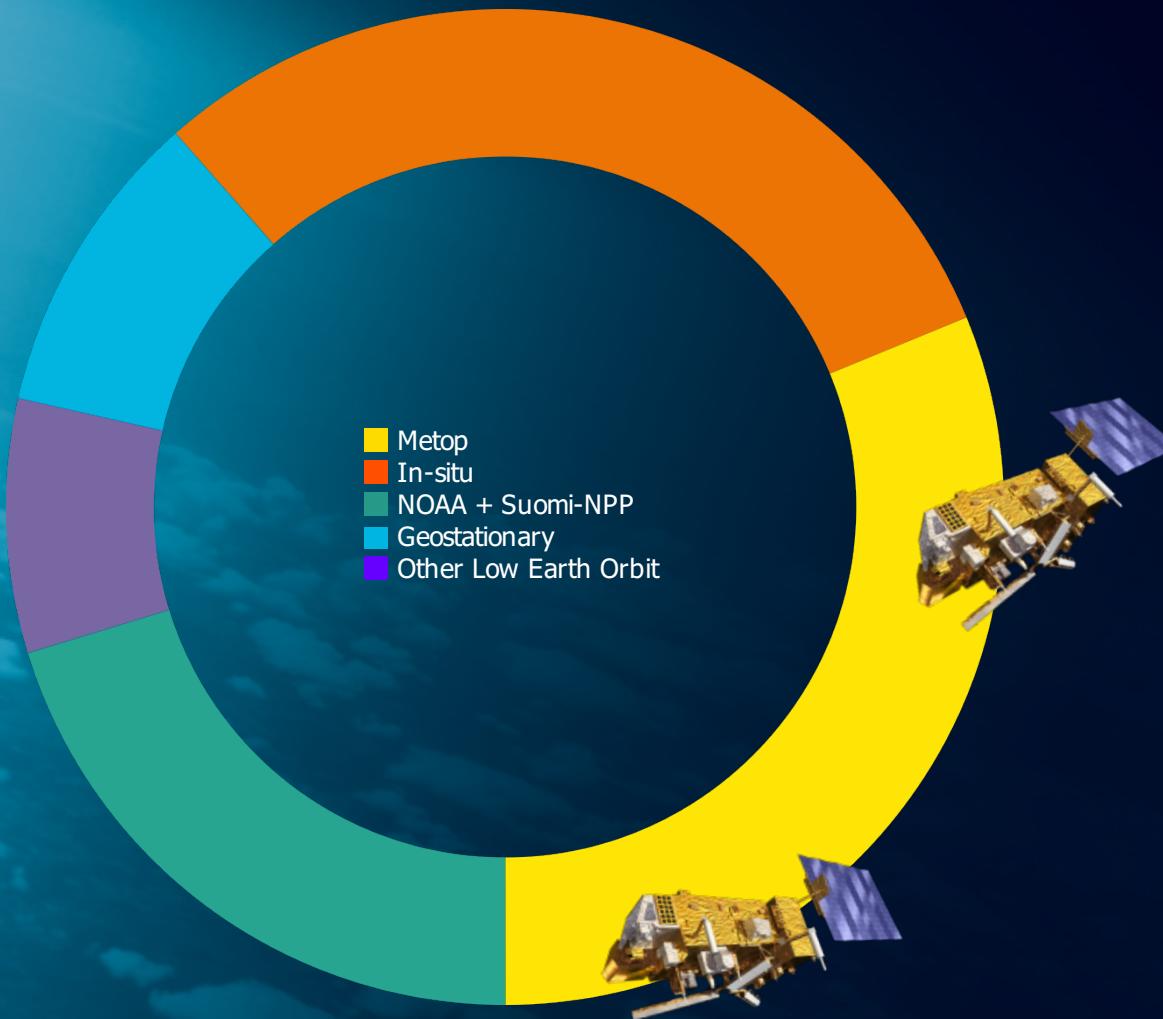
Jaune : Soyez attentifs si vous pratiquez des activités sensibles au risque de phénomènes dangereux. Des phénomènes habituels dans la région mais occasionnellement dangereux peuvent se produire. Les prévisions sont en effet prévisus; tenez-vous au courant de l'évolution de la situation.

Vert : Pas de vigilance particulière. Les cartes de vigilance météo paraissent 2 fois par jour à 10h et 22h.  
En cas de vigilance orange ou rouge, des bulletins de survol sont disponibles.

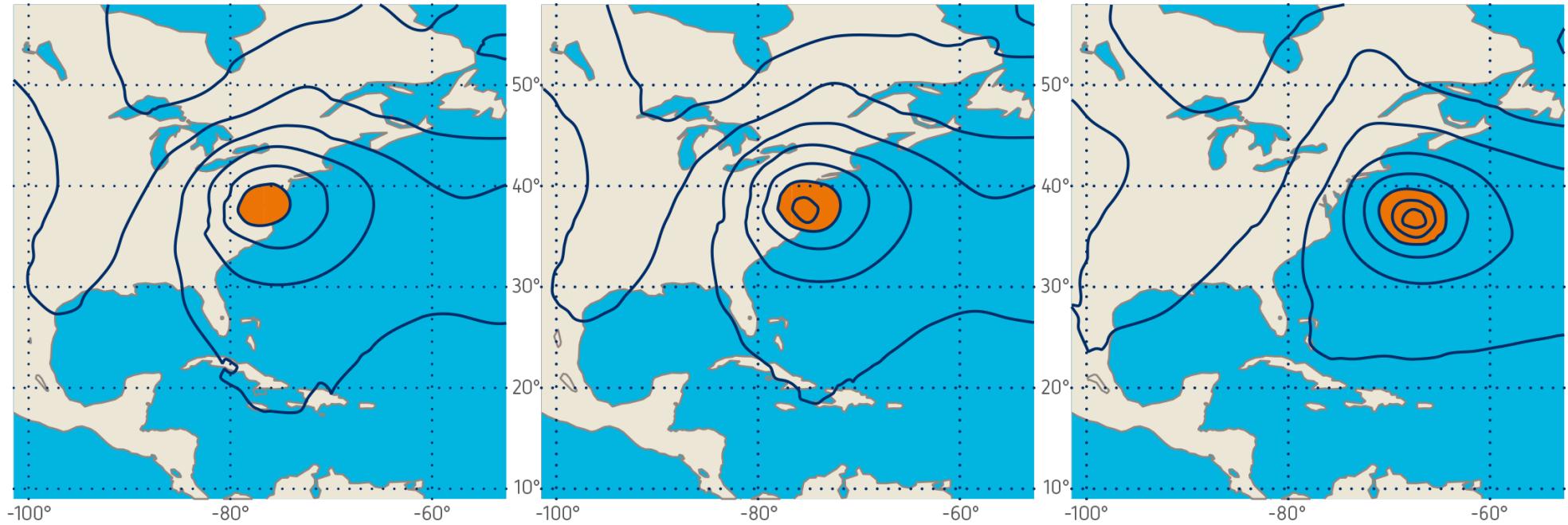
# EUMETSAT Polar System: part of the Initial Joint Polar System shared with the US



# Impact of EUMETSAT satellites on NWP

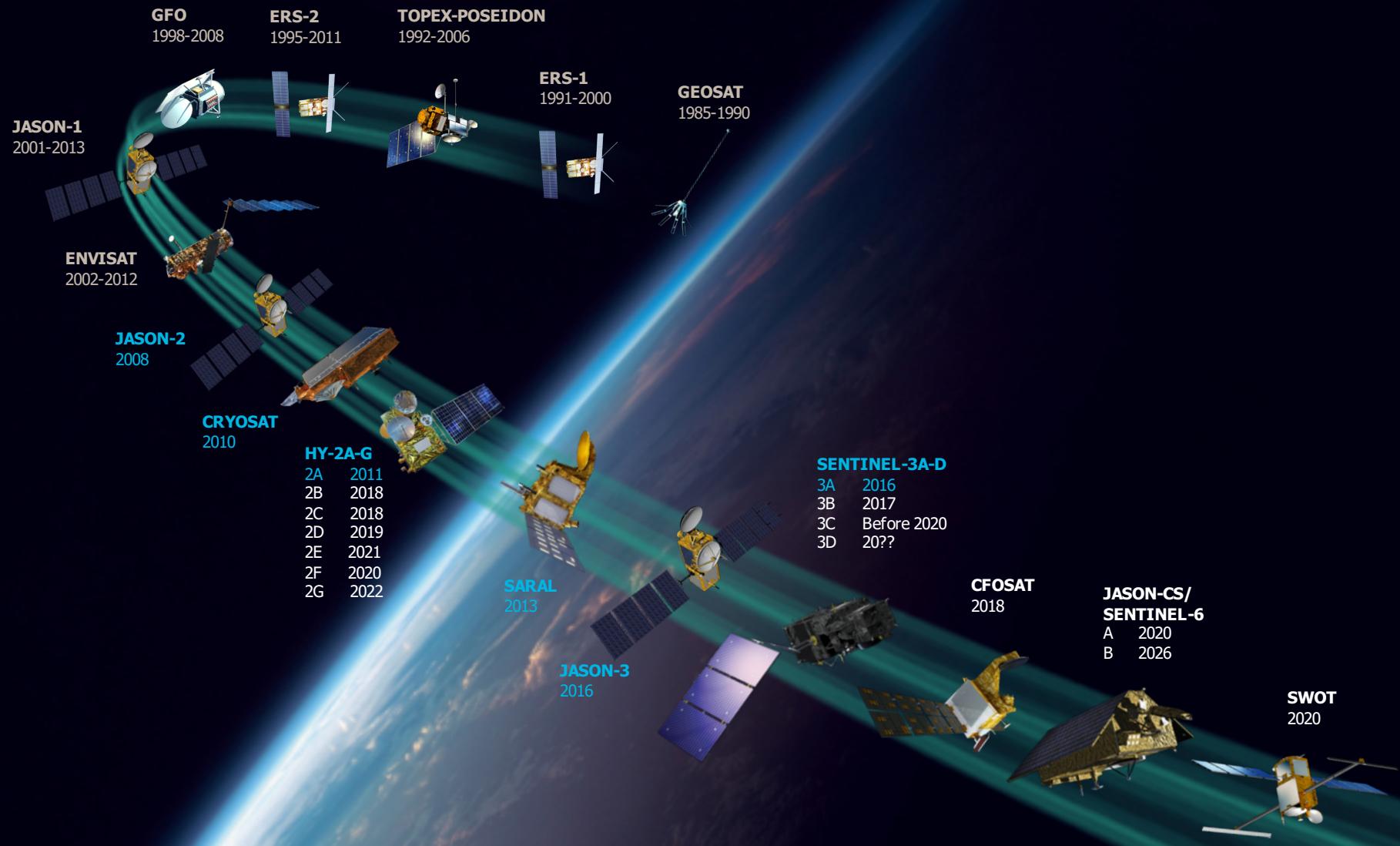


# EPS contribution to numerical weather prediction

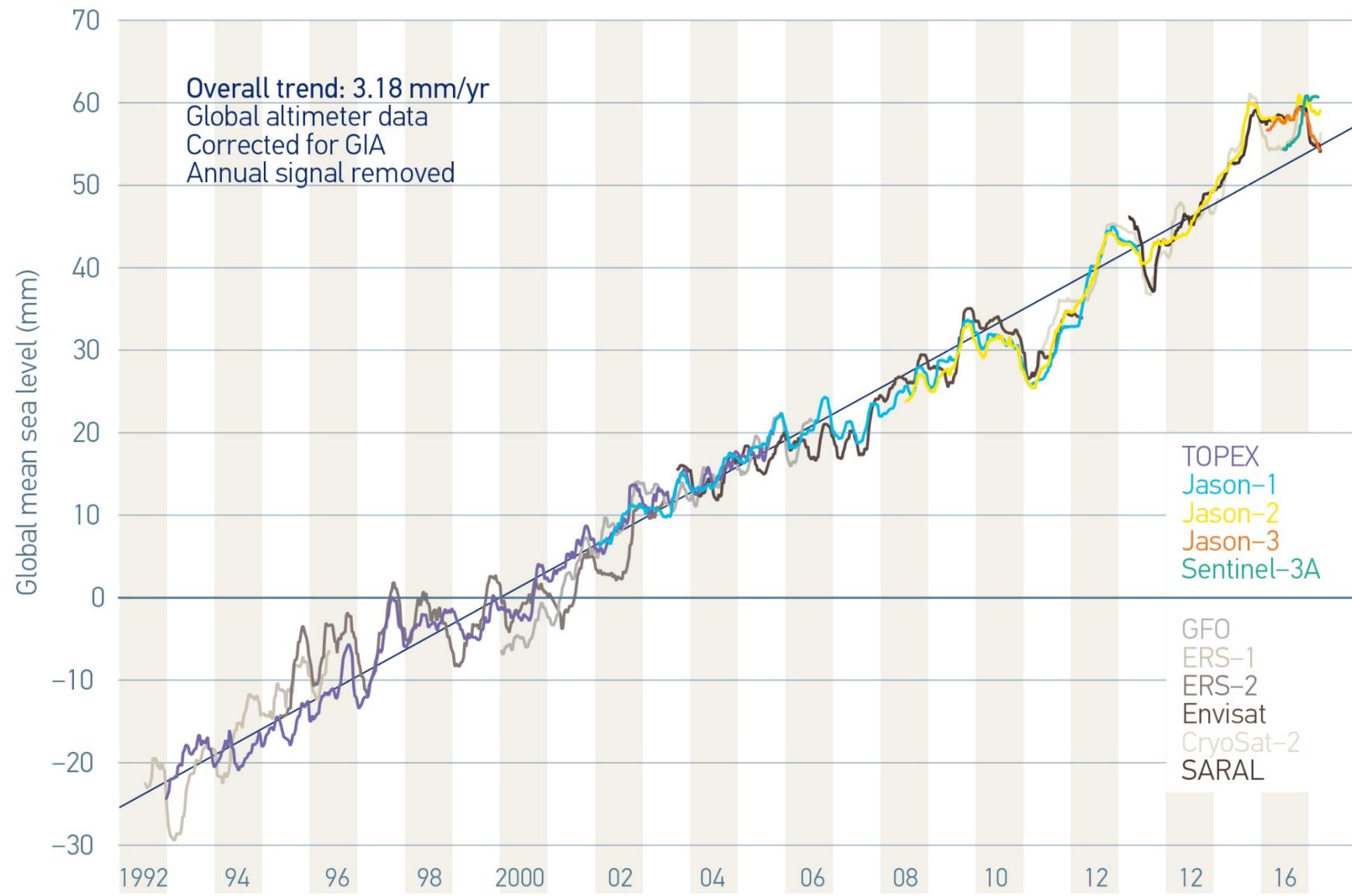


**Five-day forecast of cyclone Sandy landfall on the US coast by the ECMWF global model, with (left) and without (right) ingestion of observations from polar orbiting satellites, compared to the operational analysis (best approximation of ground truth, centre)**

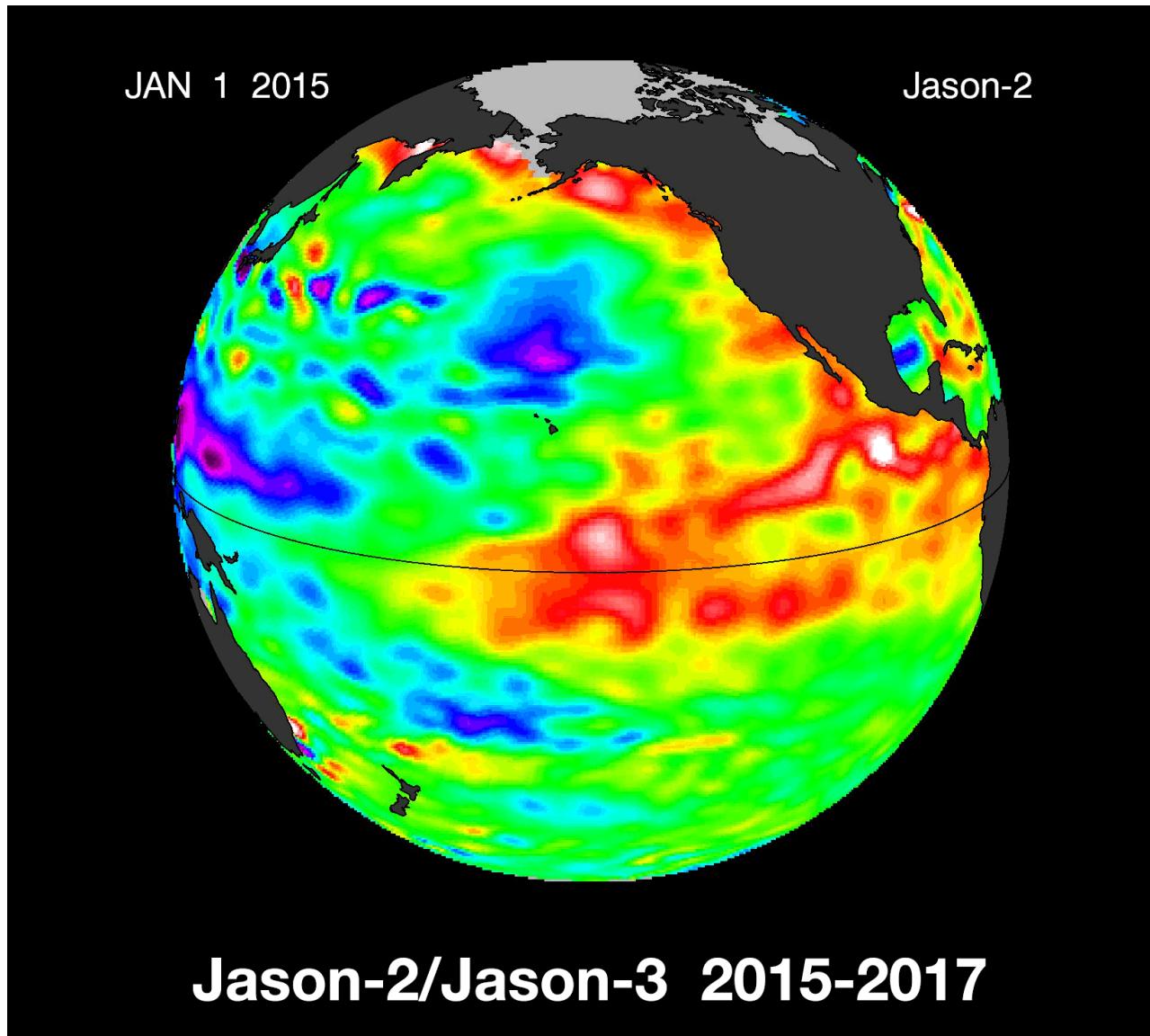
# Altimetry missions – past, present, future



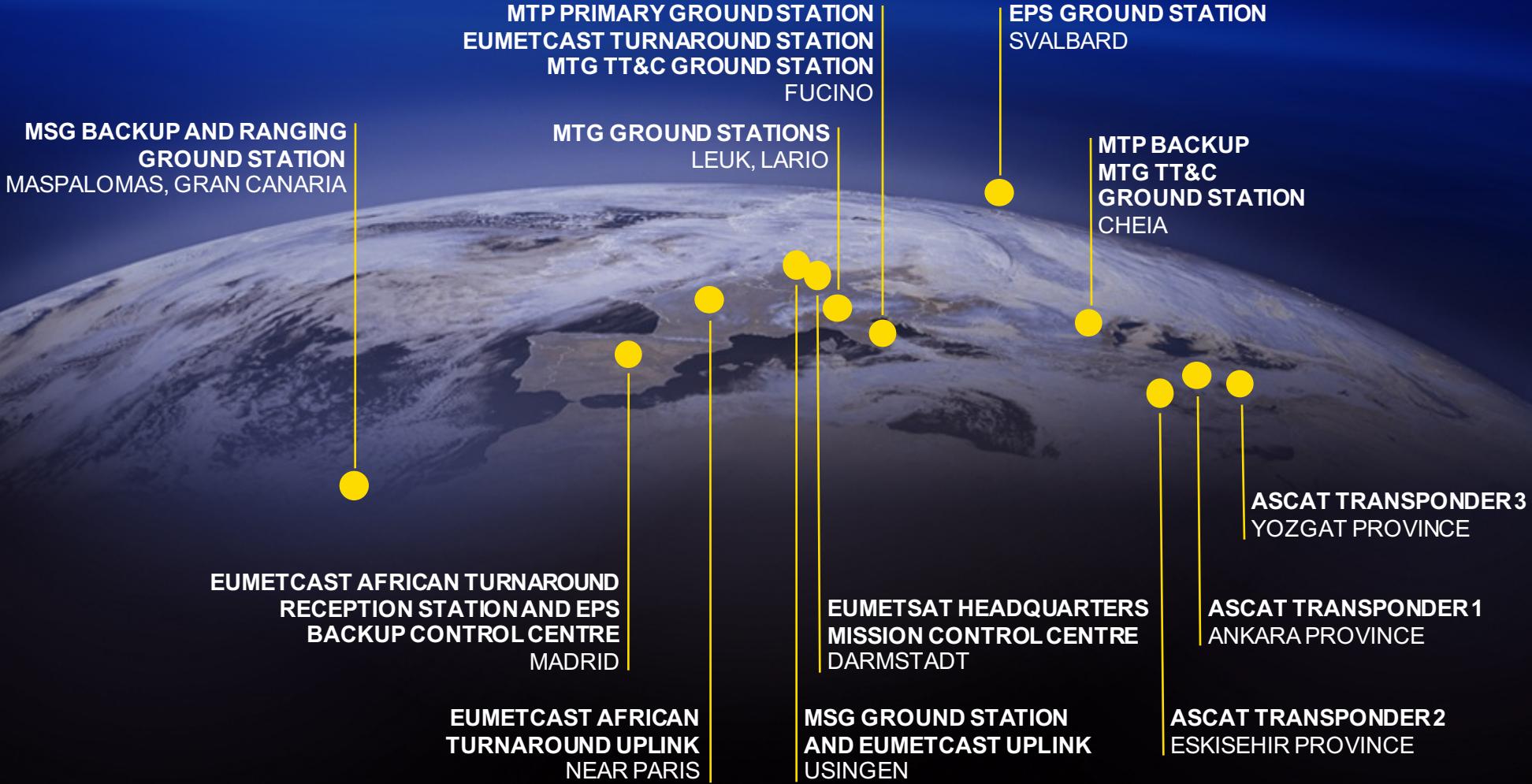
# Jason contributing to mean sea level observations



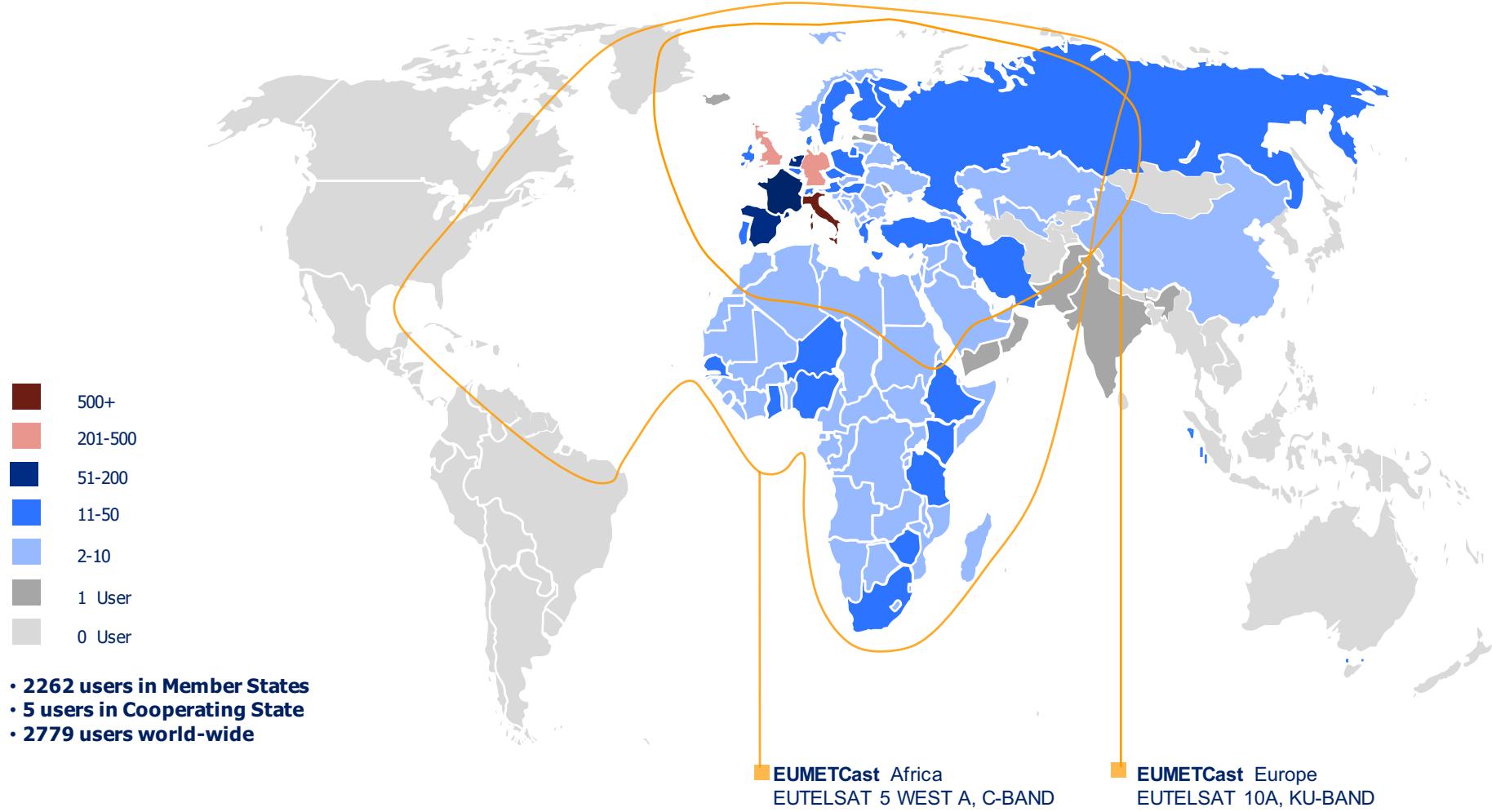
# Jason-3 contributing to El Nino observations



# EUMETSAT ground systems across Europe

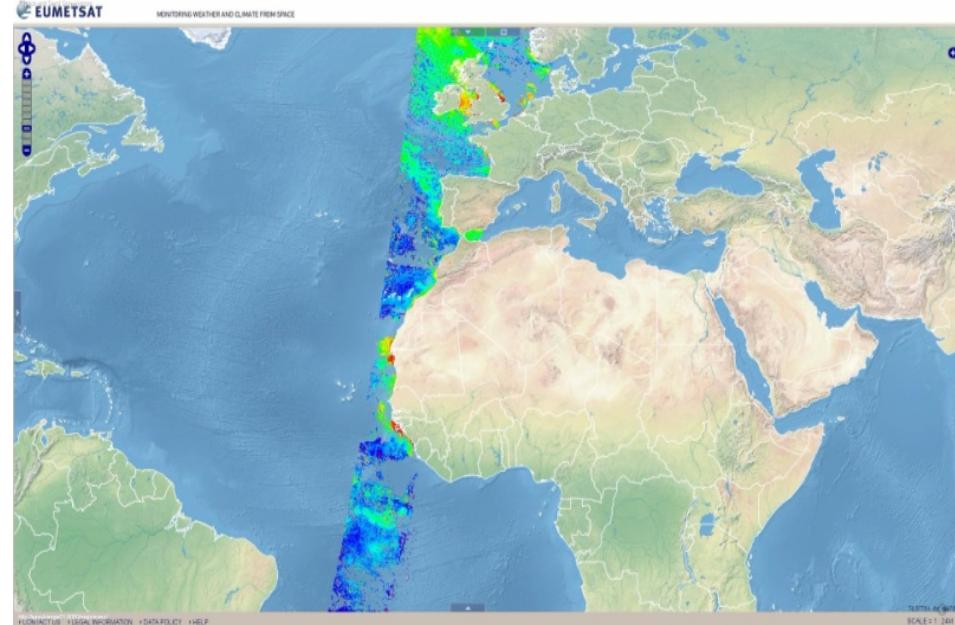
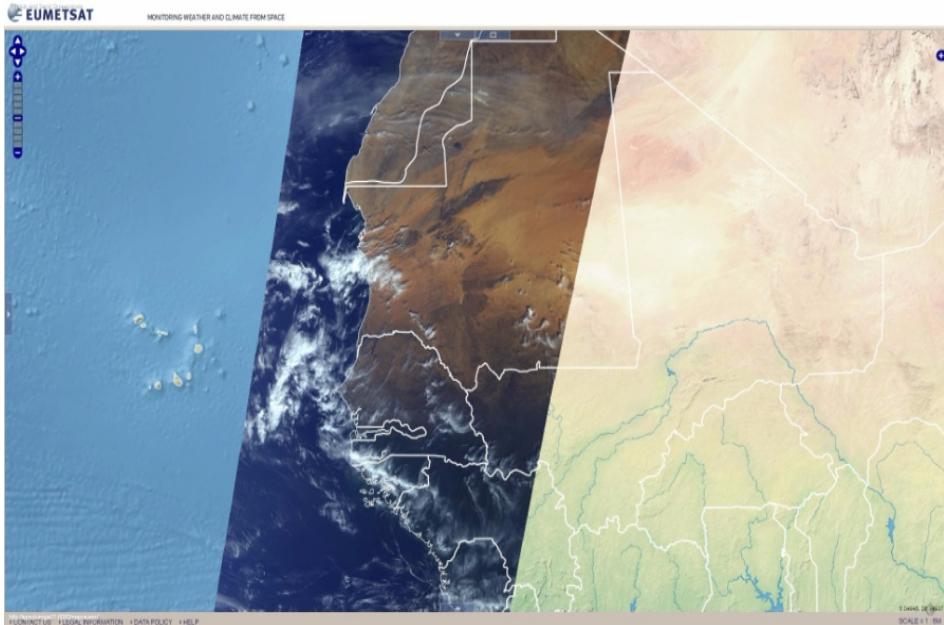


# Delivering time-critical data to three continents



23 May 2017

# • Online access to data



- EUMETView: visualisation service to view EUMETSAT (Meteosat & Metop) and Copernicus Sentinel-3 marine imagery in an interactive way using an online map viewer.

# Online access to data

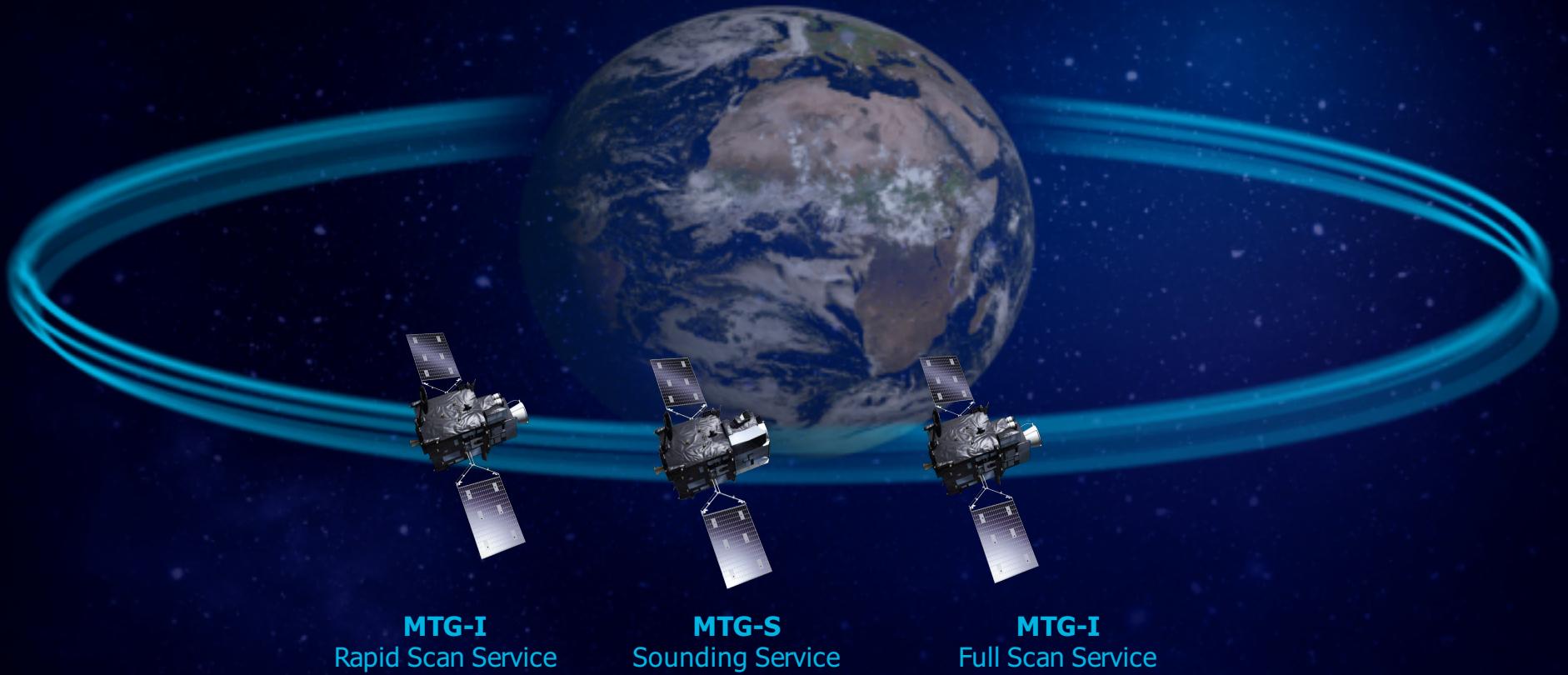
|   |  |   |
|---|--|---|
|    | <a href="http://eoportal.eumetsat.int">eoportal.eumetsat.int</a>   | create and manage your user account, subscribe to our services  |
|    | <a href="http://navigator.eumetsat.int">navigator.eumetsat.int</a> | explore our catalogue, what and where, supporting documentation |
|    | <a href="http://eumetcast.com">eumetcast.com</a>                   | learn more about our push delivery service                      |
|    | <a href="http://coda.eumetsat.int">coda.eumetsat.int</a>           | download Sentinel-3 marine and atmosphere data                  |
|   | <a href="http://archive.eumetsat.int">archive.eumetsat.int</a>     | order past data   |
|  | <a href="http://eumetview.eumetsat.int">eumetview.eumetsat.int</a> | visualise and explore, create layers in GIS applications        |

# EUMETSAT Data Centre



- Archive dating back to 1981
- 1.0 Petabytes stored
- 1.5 Petabytes retrieved annually
- Raw and reprocessed data, centrally and decentrally produced
- Networked with Satellite Application Facilities (SAFs)
- Access online via Product Navigator

# MTG full operational configuration



# MTG-I imaging mission



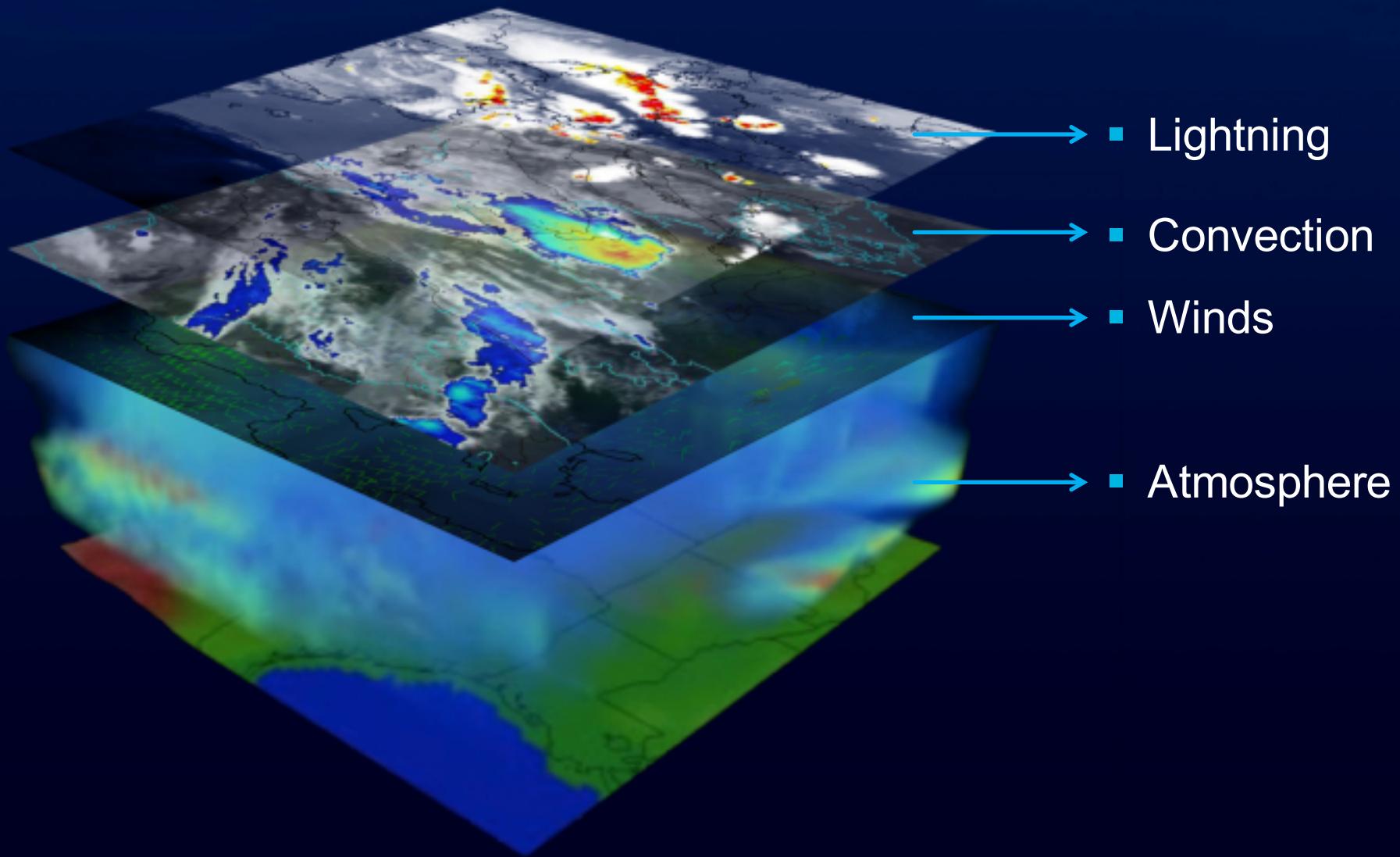
- Imagery mission implemented by two MTG-I satellites
- Full disc imagery every 10 minutes in 16 bands
- Fast imagery of Europe every 2.5 minutes
- New Lightning Imager (LI)
- Start of operations in 2021
- Operational exploitation: 2021-2042

# MTG-S sounding mission

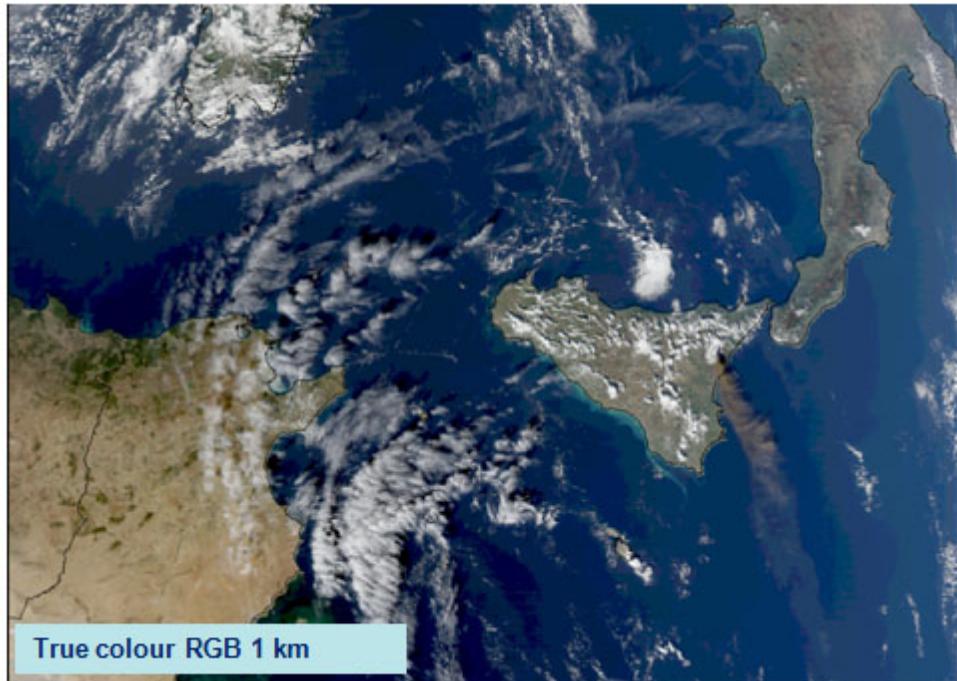
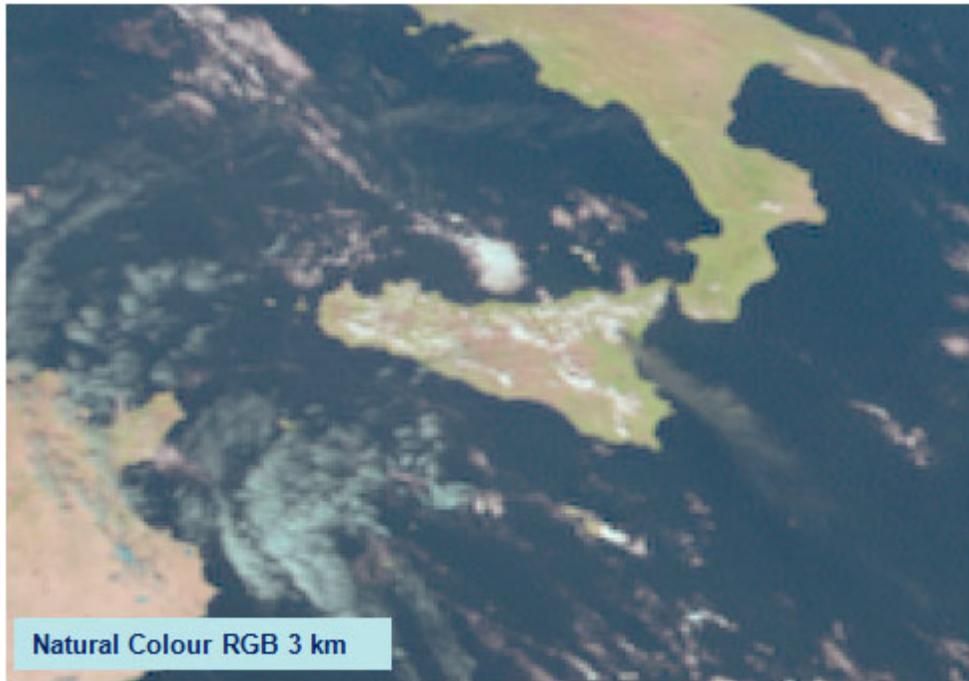


- Hyperspectral infrared sounding mission
- 3D weather cube: temperature, water vapour, O3, every 30 minutes over Europe
- Air quality monitoring and atmospheric chemistry in synergy with Copernicus Sentinel-4 instrument
- Start of operations in 2023
- Operational exploitation: 2023-2042

# 4D weather cube with MTG-I and MTG-S

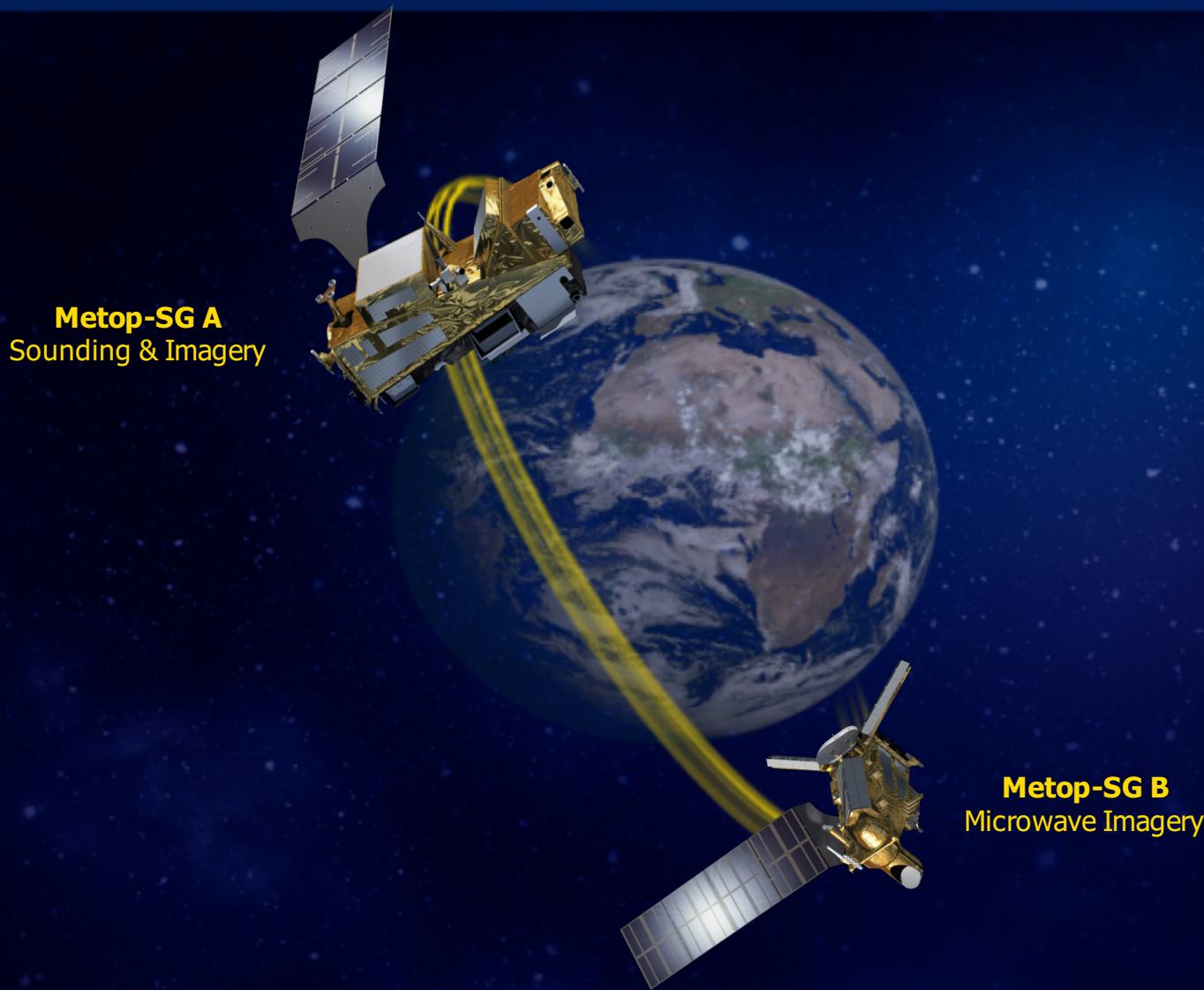


# MTG – higher resolution imagery



Example of ash detection, SEVIRI Natural Colour RGB,  
12:15 UTC, 26 November 2006 (left), MODIS True Colour  
RGB, 12:20 UTC, 26 November 2006

# EPS-SG full operational configuration



# EPS-SG A sounding and imagery mission



- 1. IASI-NG**  
Infrared Atmospheric Sounding
- 2. MWS**  
Microwave Sounding
- 3. METImage**  
Visible-Infrared Imaging
- 4. RO**  
Radio Occultation
- 5. 3MI**  
Multi-viewing, -channel, -polarisation  
Imaging
- 6. Copernicus Sentinel-5**  
UN/VIS/NIR/SWIR Sounding

# EPS-SG B microwave imagery mission

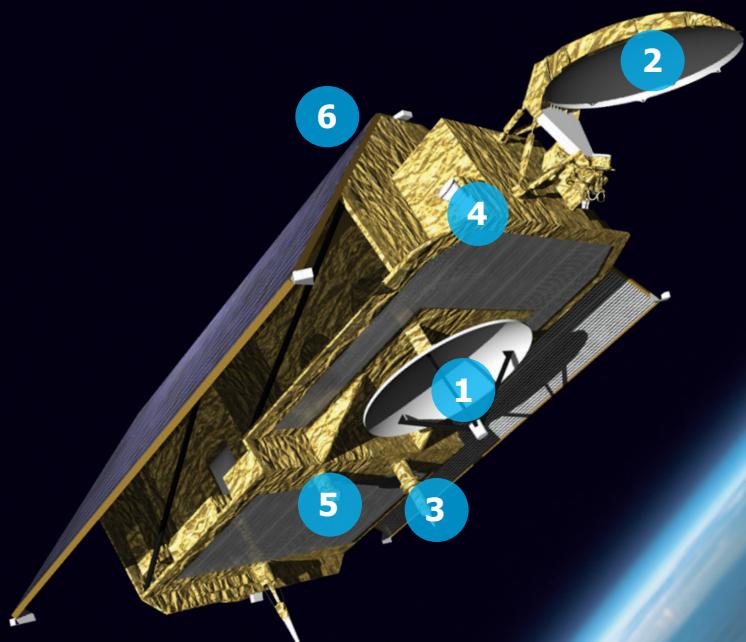


1. **SCA**  
Scatterometer
2. **RO**  
Radio Occultation
3. **MWI**  
Microwave Imaging for Precipitation
4. **ICI**  
Ice Cloud Imager
5. **ARGOS-4**  
Advanced Data Collection System

# EPS-SG mission capabilities

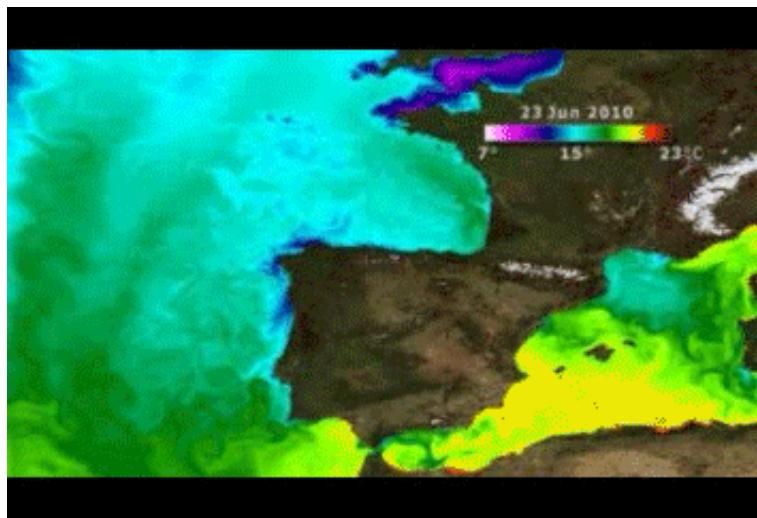
- Major improvements to all EPS observation missions
  - Infrared and microwave sounding
  - Optical imagery (METImage, developed by DLR)
  - Scatterometer
  - Radio occultation
- New imagery missions:
  - 3MI: first operational imaging polarimeter
  - MWI: microwave imagery of precipitation
  - ICI: Ice Cloud imagery

# Jason-CS

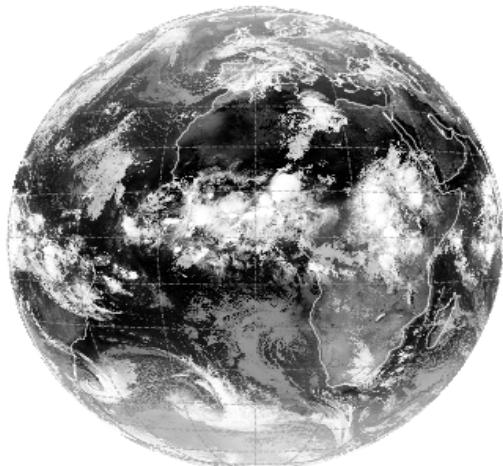


- 1. Poseidon-4**  
Dual Frequency Altimeter
- 2. AMR-C**  
Advanced Microwave Radiometer
- 3. DORIS**  
Doppler Orbitography and Radiopositioning Integrated by Satellite
- 4. GNSS RO**  
GNSS Radio Occultation
- 5. LRA**  
Laser Retroreflector Array
- 6. GNSS POD**  
GNSS Precise Orbit Determination  
*(unseen on top of the satellite)*

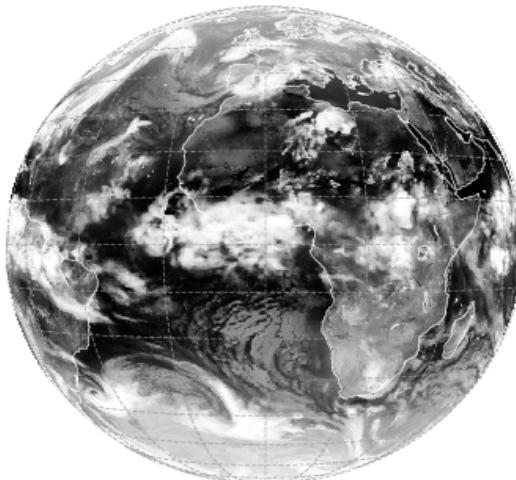
# From weather to environmental forecasting



Meteosat 9 IR10.8 20080525 0 UTC

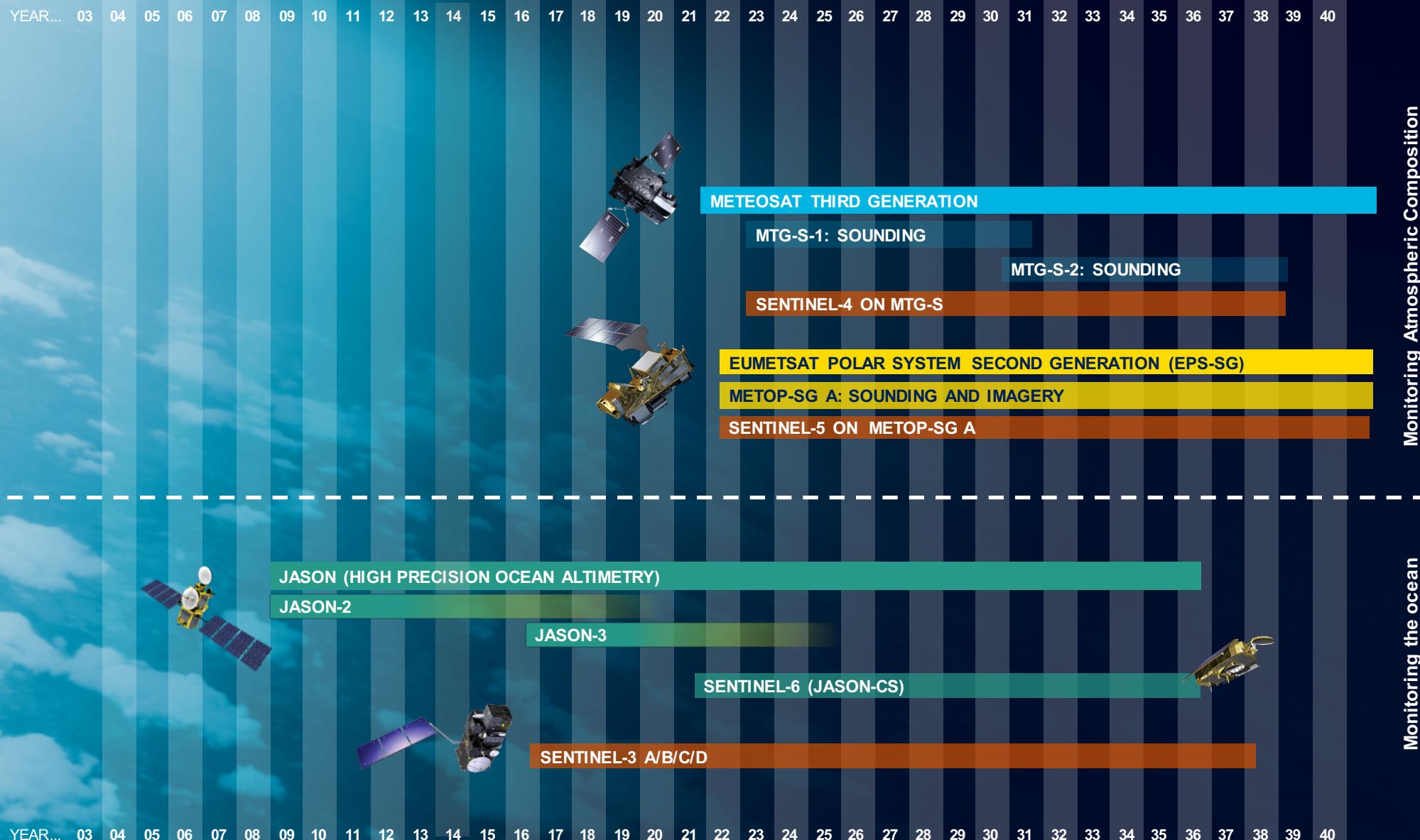


ECMWF Fc 20080525 00 UTC+0h:

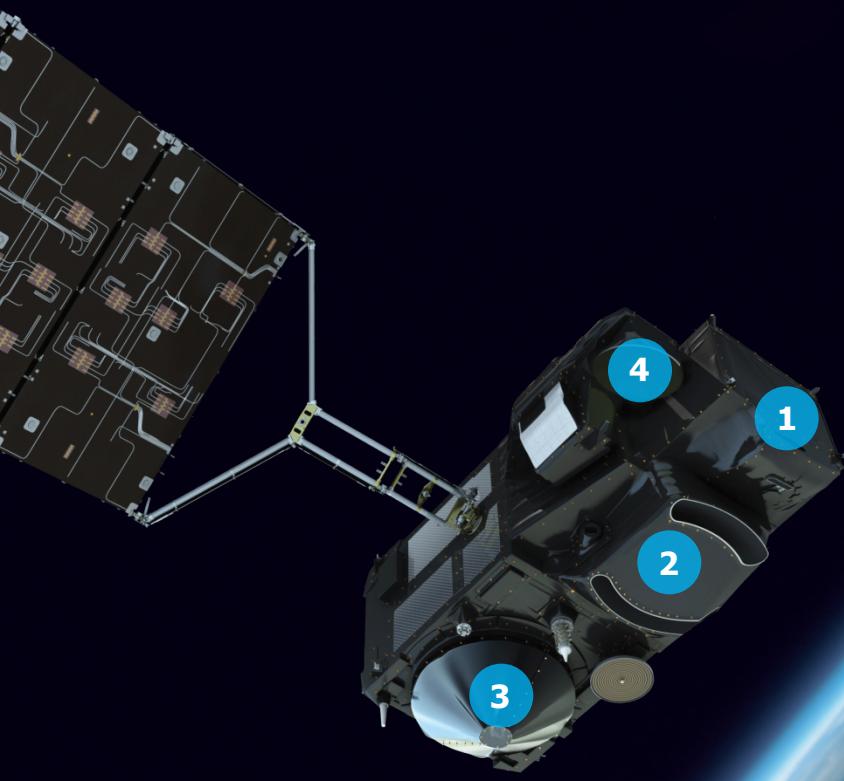


# Third party programmes in support of Copernicus

COPERNICUS



# Sentinel-3



- 1. OLCI**  
Ocean and Land Colour Instrument
- 2. SLSTR**  
Sea and Land Surface Temperature Radiometer
- 3. SRAL**  
SAR Radar Altimeter
- 4. MWR**  
Microwave Radiometer



# EUM↔NOAA Cooperation

# EUM↔NOAA Cooperation (1)

- Cooperation in satellite meteorology, oceanography and climate monitoring
- Focus on operational data exchange, data redistribution, production of climate-relevant datasets, scientific exchange, user training, coordination through multilateral partnerships (CGMS, CEOS, GEO)

# EUM↔NOAA Cooperation (2)

- Joint programmes:
  - Joint Polar System – EPS-SG and JPSS
  - Altimetry - Jason-CS/Sentinel-6
- Data Exchange & Distribution:
  - MSG at 0deg & IODC
  - GOES-R
  - GEONETCast
- Science:
  - Many joint science activities

That's it ....